(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
7 December 2000 (07.12.2000)

PCT

(10) International Publication Number
WO 00/74171 A1

(51) International Patent Classification[7]: H01Q 1/22, 1/24

(21) International Application Number: PCT/SE00/01018

(22) International Filing Date: 19 May 2000 (19.05.2000)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
9902002-6 31 May 1999 (31.05.1999) SE
9902949-8 19 August 1999 (19.08.1999) SE

(71) Applicant *(for all designated States except US)*: ALLGON AB [SE/SE]; Antennvägen 6, S-187 80 Taby (SE).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: PALIN, Ulf [SE/SE]; Tuskövägen 1, S-184 97 Ljusterö (SE).

(74) Agent: EHRNER & DELMAR PATENTBYRÅ AB; Box 103 16, Gumshornsgatan 7, S-100 55 Stockholm (SE).

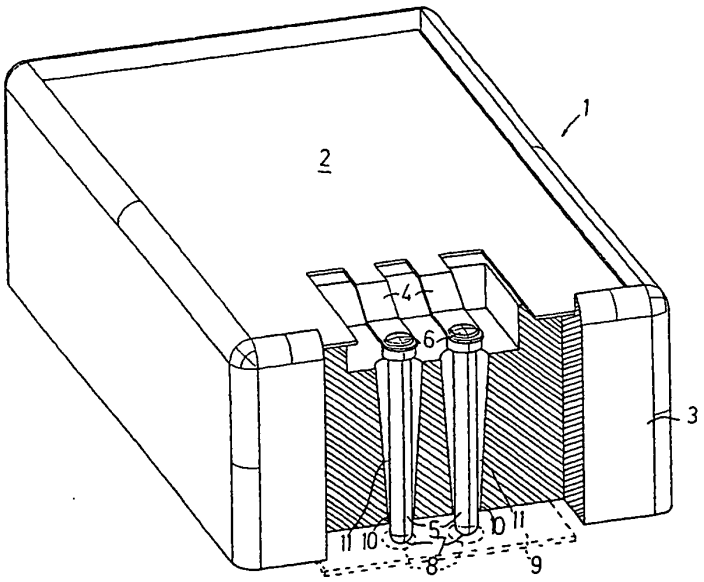
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AT (utility model), AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, CZ (utility model), DE, DE (utility model), DK, DK (utility model), DM, DZ, EE, EE (utility model), ES, FI, FI (utility model), GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KR (utility model), KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (utility model), SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:
— *With international search report.*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: AN ANTENNA DEVICE AND A PIECE OF TELECOMMUNICATION EQUIPMENT INCLUDING SUCH A DEVICE



(57) Abstract: An antenna device (1) for mounting into a piece of mobile telecommunication equipment (12) is distinguished by connecting means being connecting pin elements (5) having a point-shaped free end (7). Each pin element (5) is provided on a resilient portion (4;13) of or in connection with the antenna element (2) so as to allow longitudinal flexing of each pin element (5). The invention also concerns a piece of telecommunication equipment including such an antenna device.

WO 00/74171 A1

AN ANTENNA DEVICE AND A PIECE OF TELECOMMUNICATION EQUIPMENT INCLUDING SUCH A DEVICE

FIELD OF THE INVENTION

This invention concerns an antenna device according to the preamble of claim 1. It also concerns a piece of telecommunication equipment including such a device.

DESCRIPTION OF RELATED ART

Mobile phones are subject to cost reduction demands as well as increasing adaptation for large series manufacture. For that purpose each element included in a mobile phone is examined and questioned with respect to manufacture friendliness and economy as well as maintained or enhanced function.

Many prior art antennas for mobile phones are fastened to the phone housing by means of a screw or a snap-in connection which provides fastening as well as electrical connection. This solution makes it necessary to provide corresponding fastening elements on the mating parts and separate male and female fastening/connecting means. The advantages of using such fastening means is the safe contact obtained, the disadvantage is the cost for producing the separate parts and for assembly.

Efforts have been made to overcome the above disadvantages by placing e.g. a patch antenna inside the mobile phone cover. In such a case, the antenna terminals have been provided with a telescopic structure including a biasing spring so as to obtain contact pressure against a contact associated with the circuitry of the mobile phone, possibly being located on the PCB of the phone. Such connectors are referred to as "pogo pins" (Trademark). This solution is, however, also costly,

since it presupposes the provision of relatively movable parts. It is also difficult to produce in a minimised format. Moreover, this solution may not provide ideal performance for transferring RF signals. In one prior art solution a patch antenna is constituted by a metal plate which provides metal plate tongues extending at a right angle from the patch. Each tongue is however bent so as to provide an outer contact part which with its straight end may be applied with a certain spring action against a contact element. The main problems with this solution are: uncontrolled resistance, poor RF performance due to undefined contact position and undefined electrical length of the elements connecting the antenna element.

SUMMARY OF THE INVENTION

It is an aim of this invention to provide an antenna device as above which provides a solution to the above mentioned problems.

This aim is obtained in an antenna device as mentioned above by the features of the characterising portion of claim 1.

This way the desired electric contact for supplying signals between the antenna and the circuitry of the mobile phone is ensured with simple and safe measures.

The construction of the connecting means makes it possible to obtain spatially precise, low resistance contact even on miniaturised contact pads associated with the circuitry, since it is possible to guide the pins with great accuracy. Varying tolerances with respect to several of the associated parts are more tolerable since the construction with rigid pins, which however must be produced to an accurately defined length, and

with well defined contact points, provide for accurate RF performance even if certain variations exist, resulting in a reduced number of rejects in production. Further, the number of elements comprising the antenna device is reduced and the simple method of assembly results in an economic solution. The pin thus is rigid and only flexes as a result of the flexing of the resilient portion. The free end of the pin provides a defined point which preferably is slightly rounded, within reasonable ranges the exact geometry here is of minor importance. A pin having a defined point and being biased by the resiliency of the resilient portion results in good contact conditions. Compare however with the prior art mentioned above where the free end of the tongue is a straight edge resulting in an undefined contact point with uncontrolled or high contact resistance.

By providing one flexing pin element for feed and one for grounding, similar accurate connection as above is provided for both these purposes. Grounding results in impedance matching of the antenna element.

It is highly preferred that the pin element or elements are directly fastened to a metal sheet making up the antenna or antennas. This dual function of the metal sheet simplifies production and reduces assembly costs by the reduction of the number of elements involved. Another advantage is the provision of the antenna function with minimal space demands.

Riveting the pin elements to the resilient portion guarantees good electric contact and efficient fastening. Normally there is no need for subsequent surface treatment if a pin is riveted to the resilient portion since the pin may be optimised with respect to material, surface treatment etc.

Riveting may be performed by a reduced sized end portion of each pin being closed up as the rivet to said portion. Minimal contact resistance is also provided at this position, which is very important with respect to such antennas.

The pin may be integral with the resilient portion which here means that the pin is made in one piece therewith without any connecting means such as rivets or solder. This solution is however not an optimal solution since it presupposes an expensive set of tools and specific manufacture in order to adapt to different applications. Furthermore, at least partial surface treatment of the pin is in practice necessary to achieve an acceptable electrical contact to e.g. a contact pad.

It is preferred that the pin elements are provided on resilient tongues which are parts of the same element as the antenna element or antenna elements. This makes it simple to control the resiliency so as to obtain the desired pressure and the desired travel length for the pins. The pressure is easily determined by dimensioning the tongues and choosing a material having the proper elasticity or resilience. When the tongues are made from a metal plate also comprising the antenna element(-s), the choice of plate thickness may be according to desired resiliency. Plate thickness is of less importance with respect to antenna function, but in regions where currents flow in the antenna element it is important to have material with good conductivity.

The device is also excellent for dual or multi-band antennas, in particular, by the two antennas working in different bands being made from a common plate metal structure, for example by punching or cutting, simple manufacture is obtained.

By shaping the antenna element or elements so as to conform with the mobile phone cover, the device may be used in minimised phones.

According to a further aspect of the invention the device includes a supporting body including guide means for the pin elements. Such a supporting body may be a single piece of plastic material including guide channels for the pin elements. The provision of such a supporting body allows enhanced function since the guide means may be designed to accurately guide the pin elements onto even a minimised contact pad, still allowing the desired flexing movement. By making the channels tapering, the mounting is simplified.

The support structure for the antenna device may also be provided in the body of the mobile phone itself, thus providing yet more simplified manufacture and assembly and enhanced economy.

DESCRIPTION OF THE DRAWINGS

Other advantages are obtained through the features of the other depended claims and will be evident from the following description of embodiments given by way of examples with reference to the annexed drawings, wherein

Fig. 1 shows, in a cut, an antenna device in an operative position inside a mobile phone,

Fig. 2 shows an antenna device according to a second embodiment,

Fig. 3 shows an antenna device according to a third embodiment,

Fig. 4 shows an antenna device according to a fourth embodiment,

Fig. 5 shows an antenna device according to a fifth embodiment,

Fig. 6 shows an antenna device according to a sixth embodiment,

Fig. 7 shows a first alternative pin configuration,

Fig. 8 shows a second alternative pin configuration,

Fig. 9 shows an antenna device according to a seventh embodiment in a partial view,

Fig. 10 shows an antenna device according to an eighth embodiment in a partial view,

Fig. 11 shows an antenna device according to a ninth embodiment in a partial view,

Fig. 12a and b show details of an antenna device according to a tenth embodiment,

Fig. 13 shows diagrammatically a section of an antenna device according to an eleventh embodiment,

Fig. 14 shows an antenna device according to a twelfth embodiment in a partial view, and

Fig. 15a and b show details of an antenna device according to a thirteenth embodiment.

DETAILED DESCRIPTION OF THE INVENTION

The antenna device 1 in Fig. 1 includes an antenna element 2 which is positioned inside orienting rims of a supporting body 3. The supporting body is adapted on the one hand for support and positioning of the antenna element and pin elements 5 (see below) and on the other hand to provide fixing onto a body portion (not shown) of the mobile phone. For that purpose the supporting body 3 and said body portion are provided with mating positioning means of a per see known kind (not shown).

The antenna element 2 is in this case made from a metal plate and is integral with resilient tongues 4, each providing spring action and each at its free end carrying a pin element 5. Each pin 5 is fastened onto a hole (not shown) at the outer part of each tongue (at 6). Each pin element also has a pointed or rounded free end 7, and upon mounting of the antenna device into the body of the mobile phone each pin 5 will contact a contact pad 8, which is associated with the circuitry of the mobile phone. The supporting body 3 includes guide means 10 for the pin elements 5 so as to ensure that the pin elements 5 are securely contacting also a very small contact pad 8. A circuit board is indicated with 9. The guide means 10 comprise guide channels 11, which in this case are tapering against the lower ends in order to facilitate placing the antenna element on the support body 3. The tapering configuration thus simplifies insertions of the straight pin elements and reduces frictions since contact is obtained essentially only at the bottom portion of each channel. The tapering configuration also allows a certain movement sideways

of the upper part of the pin element when the pin elements 5 flex due to the resiliency of the tongues. This configuration also provide for a small but important movement sideways of the pointed ends 7 at the contact pads 8, ensuring certain relative movement between these elements so as to enhance the electrical contact.

In Fig. 2 the antenna device includes an single band antenna 2 having L-shaped antenna element and straight extending resilient tongues 4, each carrying pin elements, one of which 5′ being for signal feed 5′ and the other one for grounding connection 5″. Also in Fig. 1 one of the pin elements is a signal feed pin whereas the other one is a grounding pin.

In Fig. 3 the antenna device is provided with two antenna elements 2′ and 2″ whereby a dual band antenna is formed.

In Fig 4 the device provides for fastening of the pin elements on a resilient portion 13 being integral with the antenna element. In this case the properties of the portion 13 with respect to elasticity etc. is chosen such that the tongues may be omitted.

In fig 5, the principle of the invention is adopted when another type of antenna is used. In this case the pin elements are arranged on a carrier plate 14, which in turn carries an antenna element (not shown) inside cover 15. The element may be a helix antenna or any other suitable antenna. In this and similar cases the resilient portion, such as a resilient tongue, may be provided extending from a metal plate which in turn carries an antenna element of the helix type or any other type.

It is possible to shape the antenna elements differently and also to provide circuitry such as a matching circuit, for example in the neighbourhood of the tongue or tongues. It is also possible to design the tongues and to use the length of the pin element to match the antenna function in a simple way. In particular it is possible to shape the pin elements for impedance matching purposes, for example, by having a cross section deviating from a circle or having different cross section on the pin elements and also by selecting the pin length. See for example fig 8, where pins 5 are shown having X shaped cross section. It is also possible to impedance match by selecting the distance between neighbouring pins and/or tongues.

Other signals than RF signals may be coupled over the pins, for instance signals to a loudspeaker, which may be mounted on the antenna element.

More than two pins may be attached to antenna elements at arbitrary positions, for example in order to obtain optimised signal transfer for different RF bands by feeding over different pins for different bands.

Riveting or similar fastening at the connection point between the pin element and the tongue is preferred since direct metallic contact is guaranteed. No soldering is required. By using separate pin elements it is possible to easily optimise the characteristics on the one hand of the pin elements and on the other hand of the antenna elements. The pin elements are easily manufactured and may for example be made so as to give optimal contact and low contact resistance and/or conductivity. They may e.g. be gold or nickel palladium alloy

plated whereas the antenna element may be of copper or a copper alloy without surface treatment.

The antenna device according to the invention is particularly advantageous for use with internal antennas, that is antennas provided inside the cover of a mobile phone. Since such antennas are sensitive to how they are placed inside the cover and to inferior contact, the invention provides a safe solution to problems encountered with such internal antennas.

The invention allows flexibility with possibility to adopt to a modular system easily allowing desired variations, with respect to manufacture and (ease of) assembly. The antenna device according to the invention may thus be easily mounted into the phone during assembly, by simply placing it onto the phone body. The pressing action may for example be provided by a phone cover portion exerting a holding force onto chosen parts of the device, while leaving the resilient portion free for flexing.

If only one pin element is provided on the device, see as an example fig 6, e.g. for grounding purposes, the signal feed to and from the antenna element may e.g. be provided by capacitive coupling.

The pin element may be integral with the structure providing the resilient portion, see figure 7. For that purpose the pin 5 may be manufactured as a bent metal plate portion extending from the resilient portion 4 and for instance a part making up the antenna element or the carrier structure. As was indicated above, this solution, however, suffers from some important drawbacks.

In figure 9 an embodiment is shown, wherein the pin 5 is fastened to a spiral-shaped resilient portion 34 of the antenna element 12. In this case the resilient portion is formed "inside" the antenna element so that it together with the pin is surrounded by the antenna element. This solution allows freedom in designing the antenna device and the associated holding and contacting means, and for example, the overall dimensions may be reduced compared to the case where the resilient portion or portions extend from one end of the antenna element. It also allows more freedom of choosing contact point. These advantages are also obtained if the resilient portion is partially surrounded by the antenna element, that is that an edge portion of the resilient portion also forms an edge portion of the part making up the antenna element. A resilient portion located such may have other shapes, such as linear, (see fig 8), or curved, but the spiral shape gives advantages with respect to extended spring length in a reduced area. This way of arranging the resilient portion may also lead to enhanced antenna properties, since it allows more efficient use of the radiator area, and more freedom also in antenna design per se. It also allows contacting on a more central point of the antenna element which may bring about advantages with respect to radiation propagation. Further, more freedom in respect of impedance matching is allowed. A resilient portion placed such may be separated from portions of the sheet making up the antenna element by any suitable known method, for example by stamping, laser cutting or etching.

The antenna device may be mounted inside a mobile phone in various ways. In order to reduce time for assembly and to provide for simple mounting arrangements it is preferred to provide for a reduced number of components to be assembled and

to provide for rational assembly methods. The antenna element 22 in fig 10 is provided with holes (not shown) at 33 for receiving studs protruding from a base 35 which may be the outer plastic cover of the mobile phone (diagrammatically indicated as a box in this figure). It may however also be a separate holding element or support body made of a synthetic material. Each stud is at the assembly process deformed by heating (e.g. by ultra sound) or the like so that fastening caps 16 are formed for retaining the antenna element firmly onto the base 35. A cavity is created at 37 for allowing flexing of the resilient portions 4. Fig 11 shows an embodiment where studs 17 protruding from a base 35 are extending through holes 33 in an antenna element 22. These studs 17 are still to be deformed into holding caps (16 in fig 10).

As is clear from fig 12a, an antenna device may also be fastened by an antenna element 22 being slide mounted into a slot 18 (one of two opposing slots is shown) in a base 35 which similarly may be an outer cover or a separate holder. In this embodiment it may be satisfactory, according to fig 12b, to allow pin 5 associated with the antenna element 22 to slide into a guide slot 21 in a guide body 20 in a direction according to arrow 19 being perpendicular to the general extension of the pin 5. This means that the pin is supported in almost all directions (all but one single direction, counter to arrow 19) during the flexing which is satisfactory in most applications.

Fig 13 shows a further embodiment where the antenna device and in particular the radiating antenna element 2 is firmly mounted in a mobile phone by the application of adhesive tapes. 23 denotes a lid which may or may not be a part of the

outer cover of the mobile phone. The antenna element 2 is fastened to the lid over a double adhesive tape 24. The lid 23 is in turn fastened to the remaining parts of the phone in a direction taking into account the flexing properties of the parts 4 and 5. Such an arrangement may provide sufficient fastening for many applications. In this case there is however also provided a second double adhesive tape 25 on the second side of the element 2 for fixing thereto a support body 26. As a complement there may also be provided fastening studs 17 distributed over the area of the lid. These studs 17 may be deformed with heat to form caps (see fig 10) for co-operation with support body 26.

By accurate positioning of the antenna element with respect to dielectric material, ground plane and integrated circuits included in the mobile phone, unwanted variations with respect to frequencies of the antenna device may be minimised. Such positioning is particularly important at the edges of the antenna element. Best fixation with respect to this aspect is achieved by the shown taping of both sides of the antenna element, which will provide possibility of accurately positioning it with respect to dielectric material. In some instances it is however sufficient to fasten the antenna element 2 between a lid 23 and a support body 26 without the intermediary of tapes.

Fig 14 shows positioning of an antenna element 22 inside a support body 29 by providing mating snap-lock fastening elements 27, 28 on a lid 30 and on the body 29 respectively. The elements 27, 28 may be chosen from a plurality of such elements of per se known kind and they may extend continuously over the rim of the meeting parts or be discrete separated elements.

Fig 15a shows an antenna element 22 being fastened in a support body 29 which may or may not make up a portion of an outer cover of a phone. Studs 17 extend through holes 33, said studs providing fastening of an antenna element 22 by that element 22 having holes 33 being formed with engaging means 28 which fixes the metallic antenna element onto the studs when the antenna element 22 is pressed to position. Such fastening holes are often referred to as "star-lock" elements which are per se known in the art of fasteners.

It goes without saying that also other, differently shaped, fasteners may be used. For the purpose of providing good economy, simple and reliable mounting is essential. Also direct snapping-in of an antenna element into a support body is contemplated an within the scope of the invention.

The pin is preferably connected to the resilient portion essentially perpendicular thereto when that portion is formed from a metal sheet.

The shown embodiments allow freedom to dimension these portions such that the spring force afforded to the pins may be chosen to match the specific application.

It is important that the free end of the pin is point shaped or rounded, as is discussed above, so as to provide a small contact surface and safe connection.

The antenna elements may be designed so as to be adapted to the shape of the phone cover so as to minimise the space used. For that purpose the antenna elements may be formed with curved configuration.

Claims:

1. An antenna device (1) for mounting into a piece of mobile telecommunication equipment (12), comprising at least one antenna element (2) for transmitting and/or receiving RF-signals, and at least one connecting means for electrically connecting each antenna element to circuitry of said piece of equipment, **characterized in** that each connecting means is a connecting pin element (5), extending essentially in a first direction and having a point-shaped free end (7), and that each pin element (5) is provided on a resilient portion (4;13) of or in connection with the antenna element (2) so as to allow longitudinal flexing of each pin element (5) essentially in said first direction.

2. A device according to claim 1, wherein two pin elements (5) are provided, a first for signal transmission and a second for grounding.

3. A device according to claim 1 or 2, wherein each antenna element (5) is formed from a metal sheet and each pin element (5) attaches (6) to the sheet.

4. A device according to any of the claims 1 - 3, wherein at least one pin element (5) is riveted to said resilient portion (4;13).

5. A device according to any of the claims 1 - 4, wherein at least one pin element (5) is integral with said resilient portion (4).

6. A device according to any of the claims 1 - 5, wherein the resilient portion is a resilient tongue (4).

7. A device according to any of the previous claims, wherein each resilient portion (4) extend outwardly from an antenna element (2).

8. A device according to any of the claims 1 - 6, wherein each resilient portion (34) is provided in an inner portion of an antenna element (12) so as to be at least partially surrounded thereby.

9. A device according to any of the previous claims, wherein the resilient portion (34) is curved, for example spiral-shaped.

10. A device according to any of the previous claims, wherein two antenna elements (2´,2´´) which are operative in different frequencies are provided.

11. A device according to any of the previous claims, wherein the shape of each antenna element is essentially according to any shape from the group consisting of the shapes of the capital letters: U, L, V, I, F, G, C, H and meander, quadrangle and helix shapes.

12. A device according to any of the previous claims, wherein each pin element (5) is surface treated so as to obtain good conductivity such as gold or nickel palladium plated.

13. A device according to any of the previous claims, wherein each antenna element is shaped so as to conform with a cover of a piece of telecommunication equipment.

14. A device according to any of the previous claims, wherein the physical dimensions of each resilient portion and/or each pin element is selected for impedance matching purposes.

15. A device according to any of the previous claims, wherein the distance between the pins is selected for impedance matching purposes.

16. A device according to any of the previous claims, wherein a piece of electronic circuitry such as a matching means is included.

17. A device according to any of the previous claims, wherein a supporting body (3) is included, having means for supporting the antenna element, guide means (10,21) for guiding each pin element in the first, flexing, direction, and having means for fastening and positioning in a piece of telecommunication equipment.

18. A device according to claim 17, wherein each guide means provides a conically tapering guide channel(11).

19. A device according to claim 17 or 18, wherein the support body (3) is made from a synthetic material.

20. A device according to any of the previous claims, wherein means (16,17,18,24,25,27,28,30,33) are provided for fastening the antenna element on a supporting structure (3,23,26,29,35).

21. A device according to claim 20, wherein the supporting structure is part of the outer cover of a mobile telephone.

22. A device according to claim 20 or 21, wherein the fastening means are chosen from the group including heat deforming elements (16,17) of synthetic material, snap-in connectors (25,26,27), friction locks (28,17) and adhesive tapes (24,25).

23. A piece of telecommunication equipment including a device according to any of the claims 1 - 22.

24. A piece of telecommunication equipment according to claim 23, including a circuit board having a contact pad (8) for contact with each pin element (5).

25. A piece of telecommunication equipment including a device according to any of the claims 1 - 22, wherein the piece of equipment is provided with a supporting structure for said device.

26. A piece of telecommunication equipment according to claim 25, having a portion including guide means for guiding each pin element in the first, flexing, direction.

27. A piece of telecommunication equipment according to any of the claims 23 - 26, wherein means are provided for fastening co-operation with the antenna device.

28. A piece of telecommunication equipment according to any of the claims 23 - 27, including a circuit board having means for contact with each pin element.

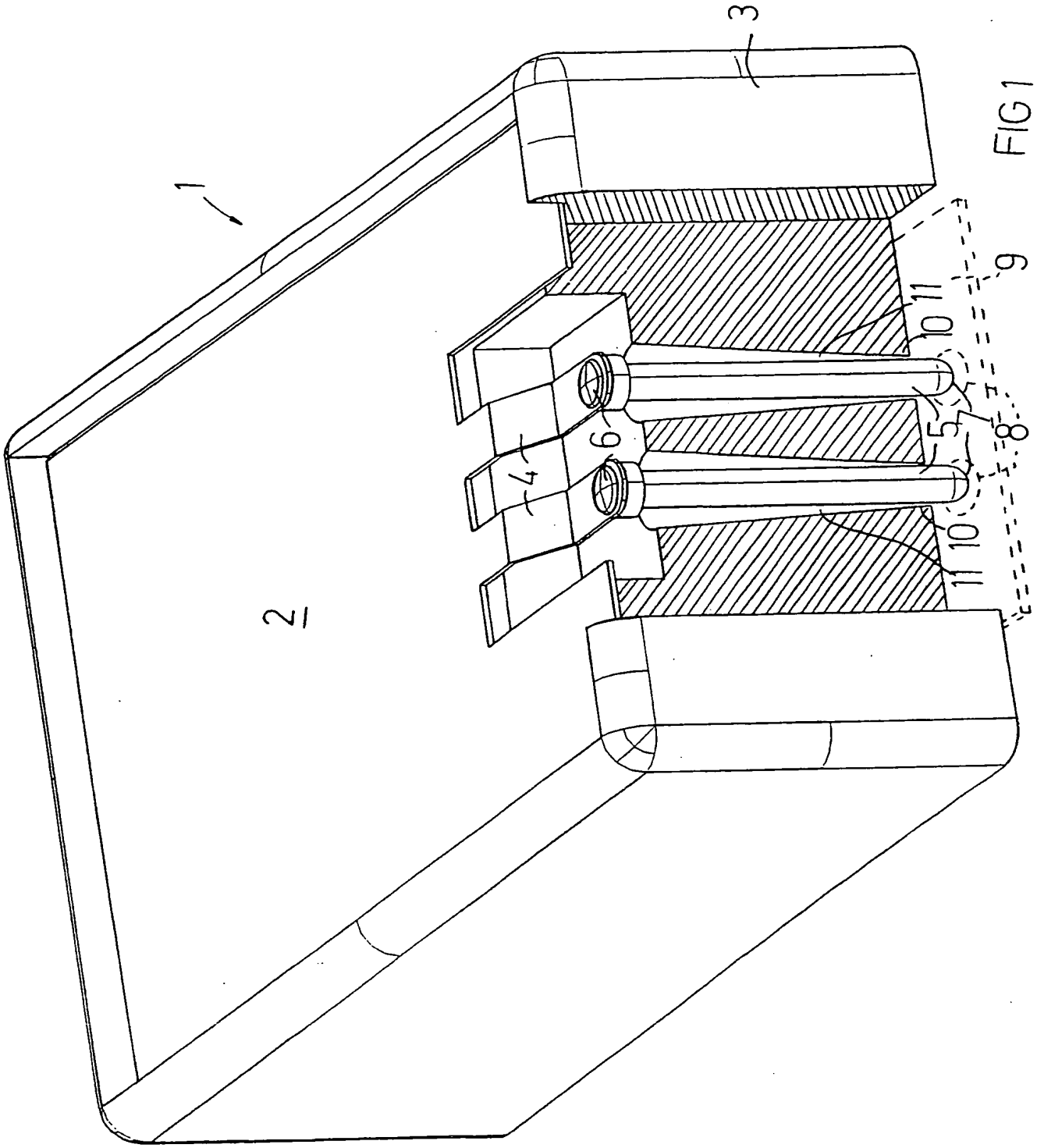


FIG 1

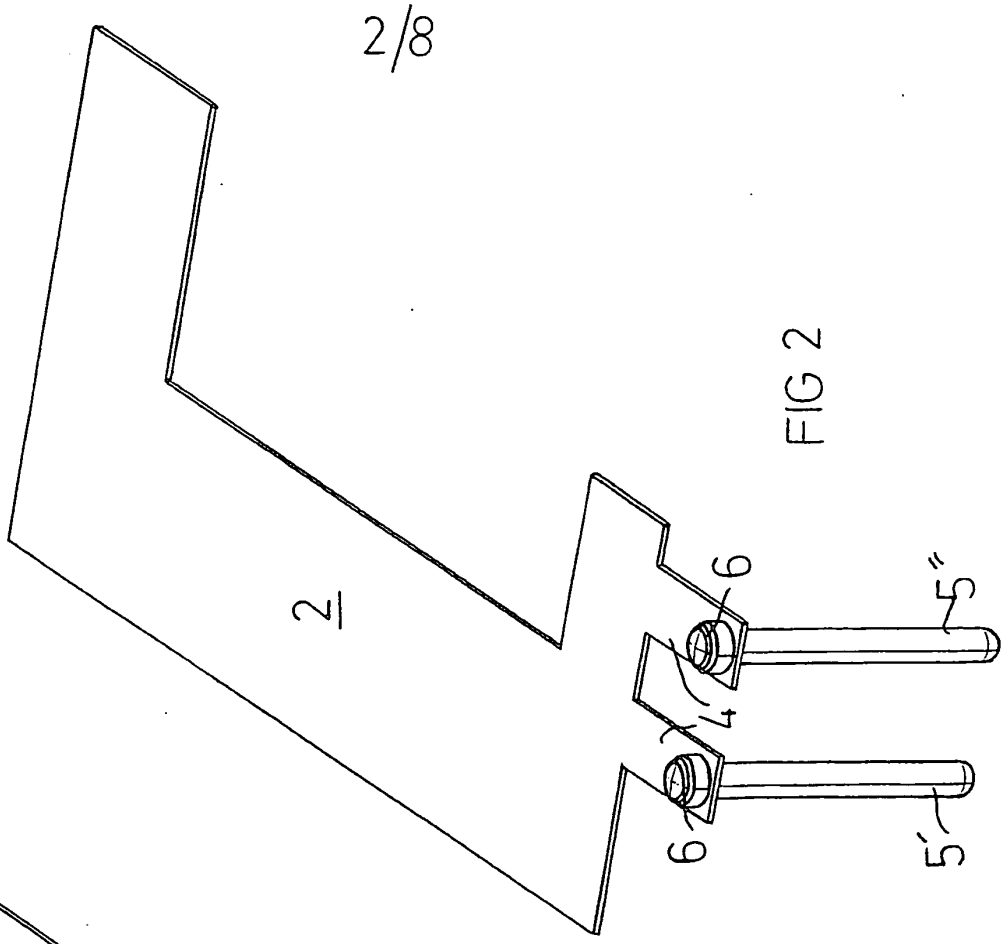


FIG 2

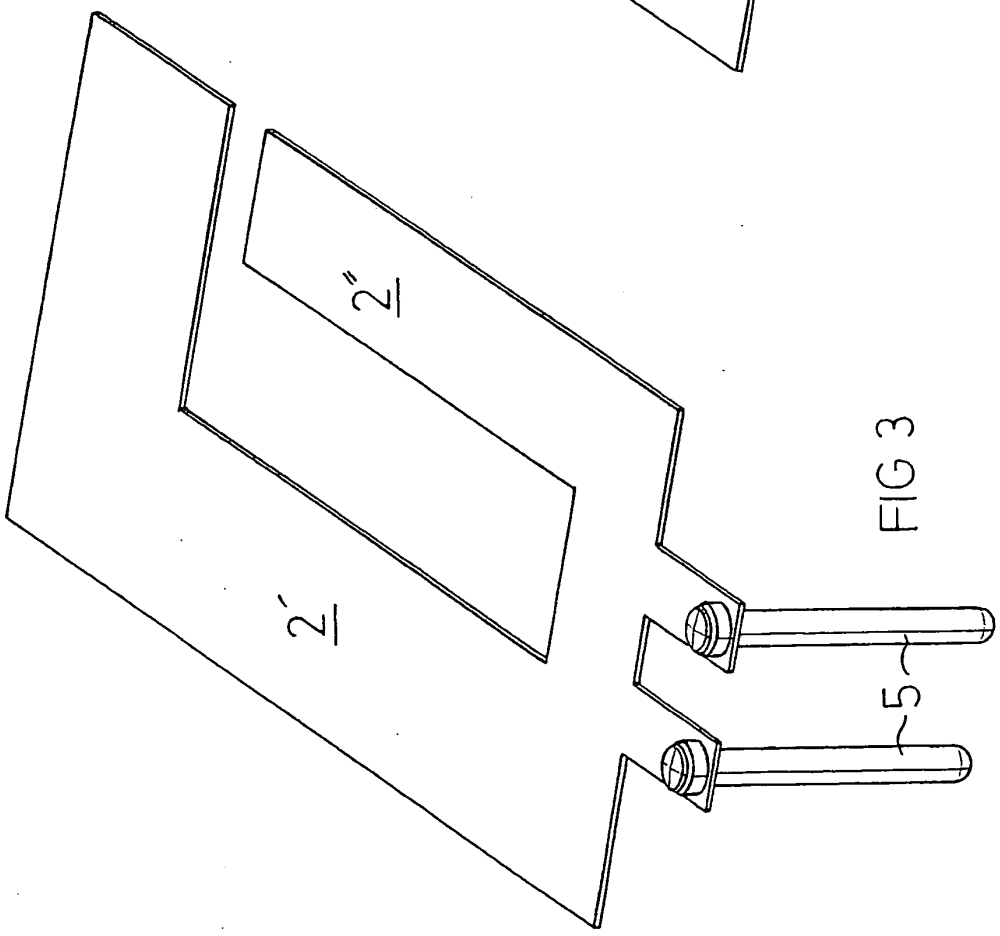


FIG 3

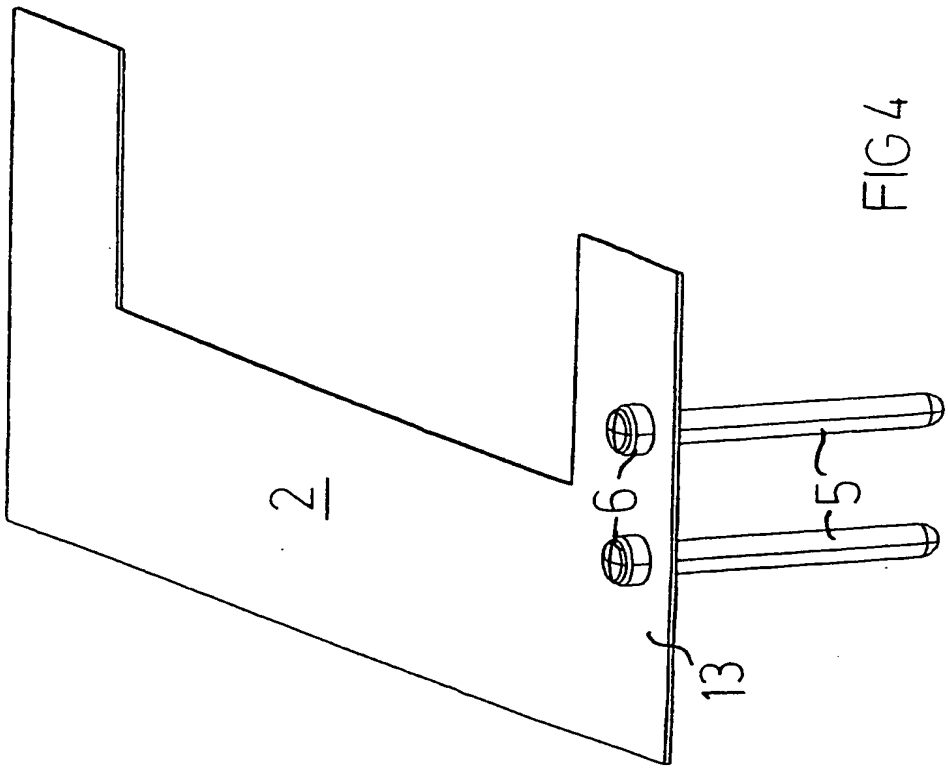


FIG 4

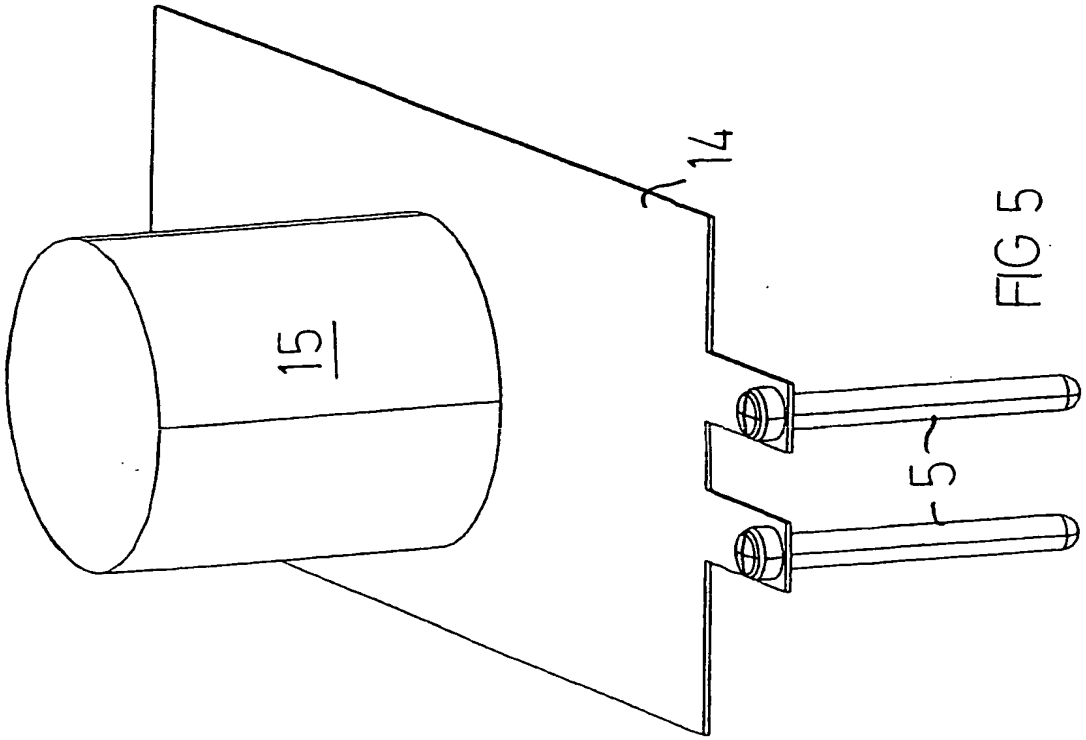


FIG 5

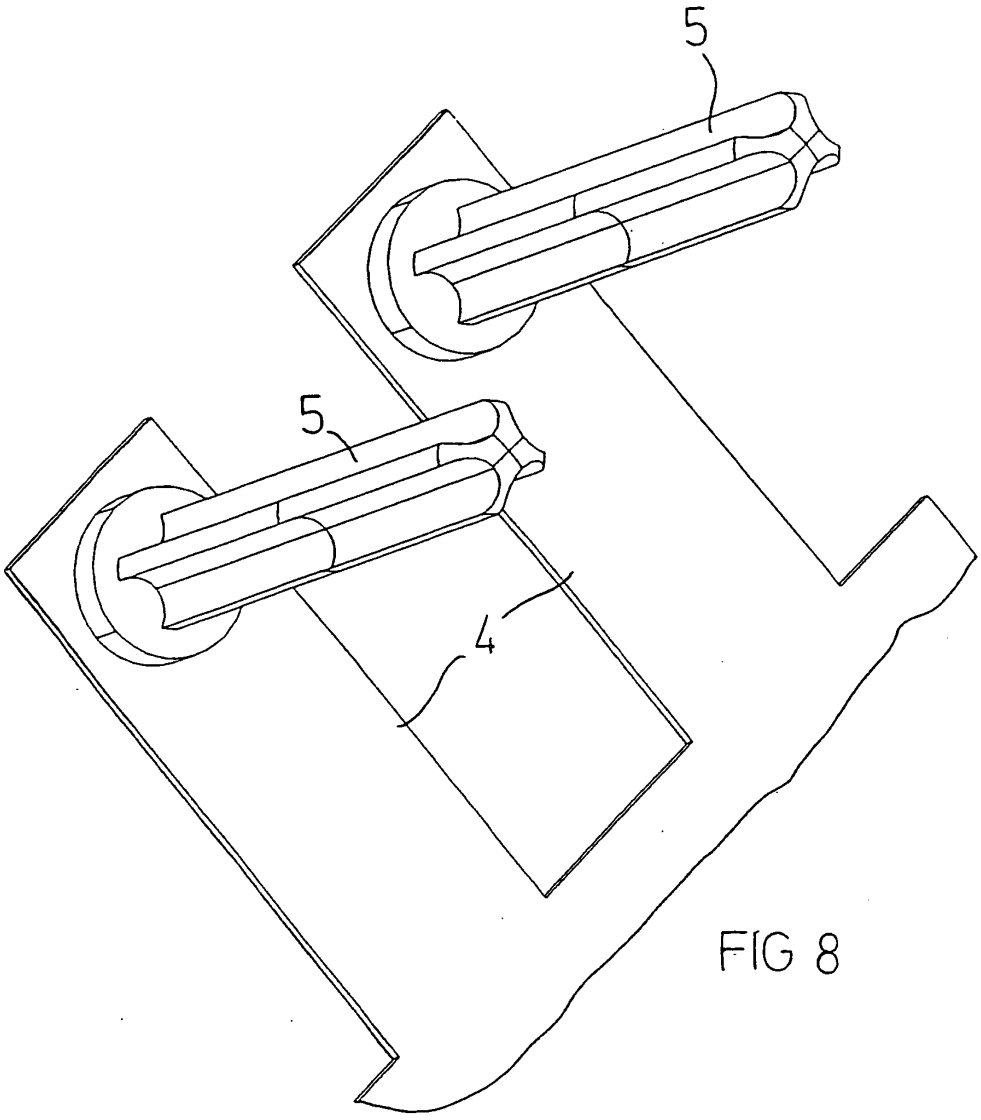


FIG 8

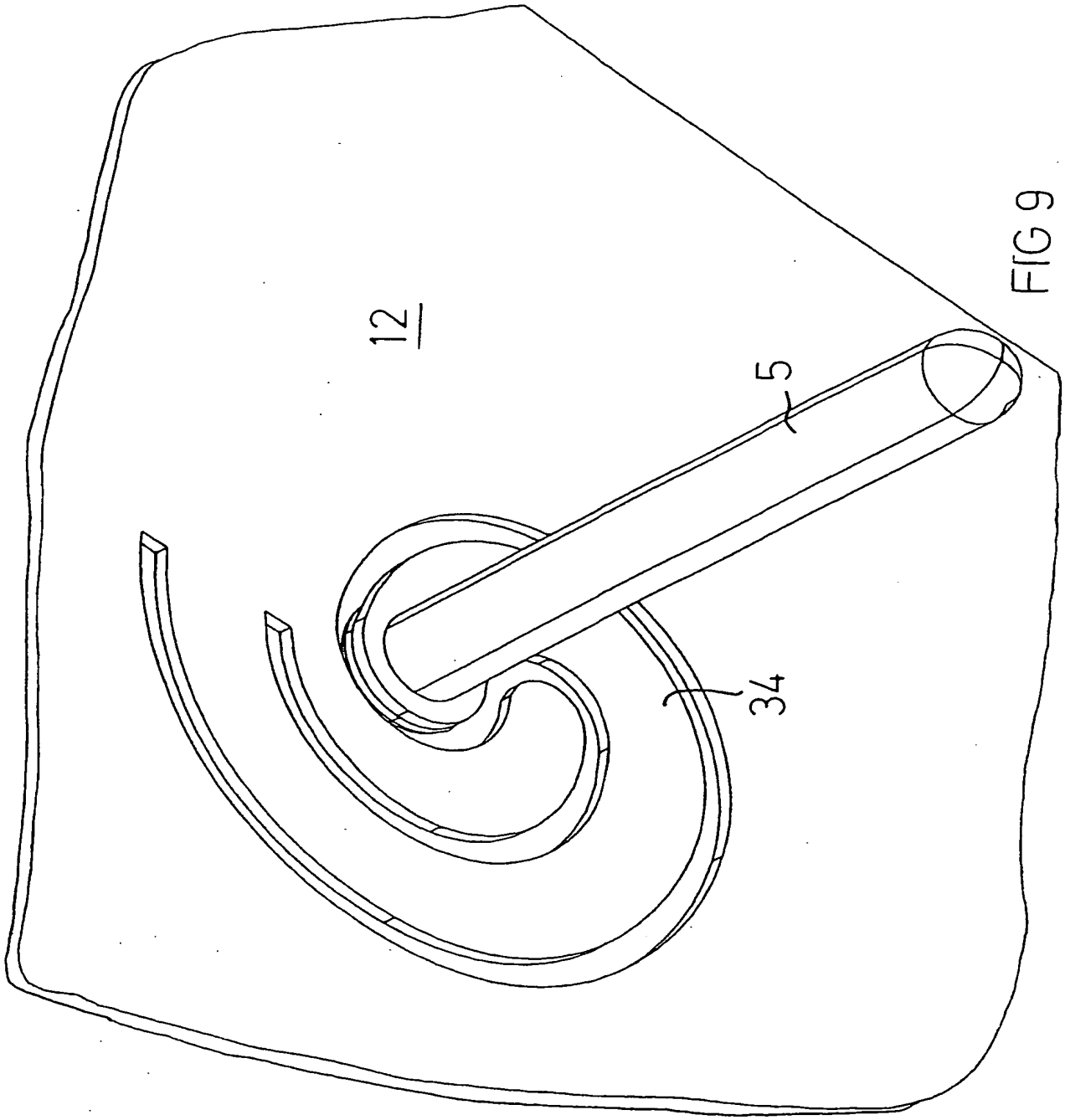


FIG 9

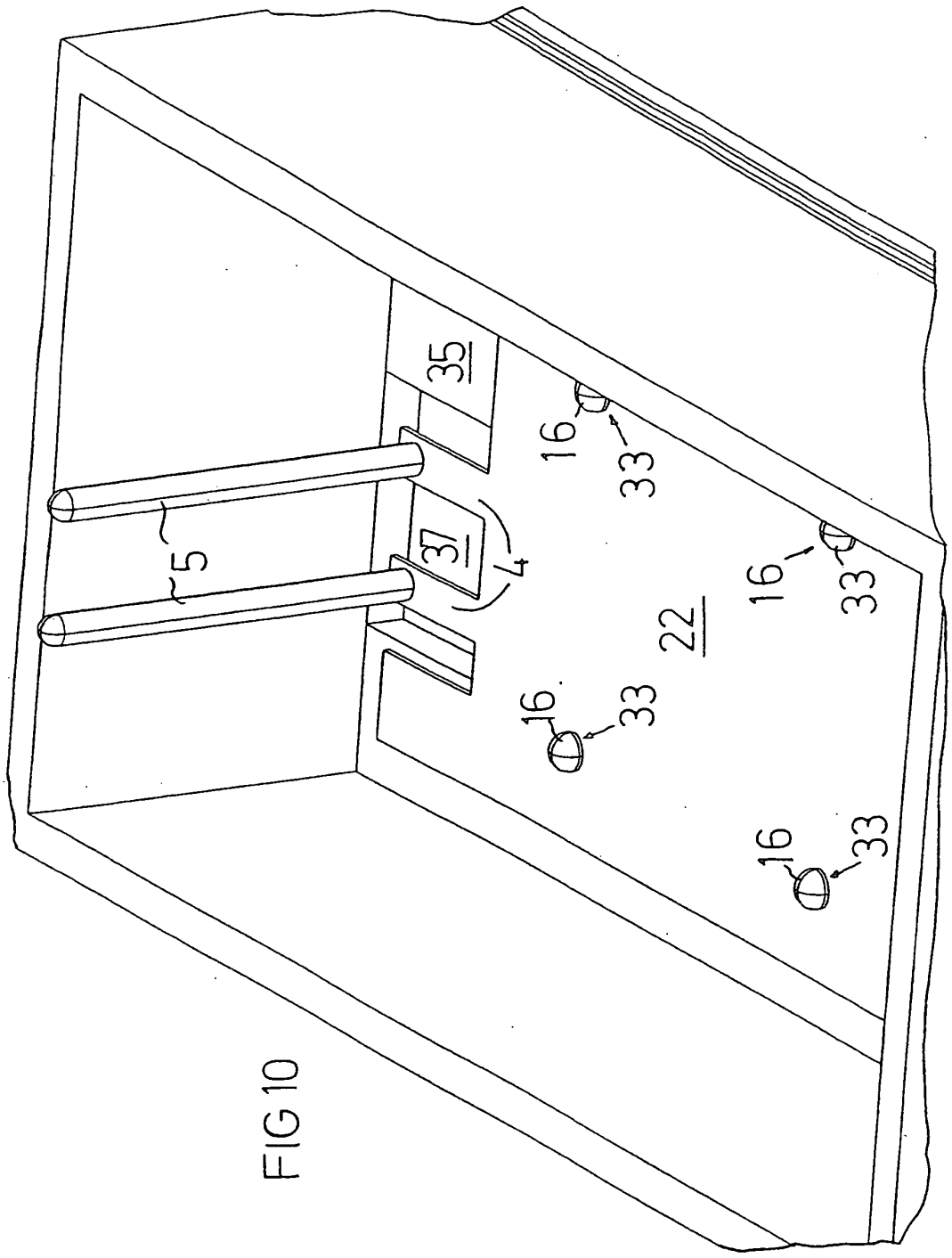


FIG 10

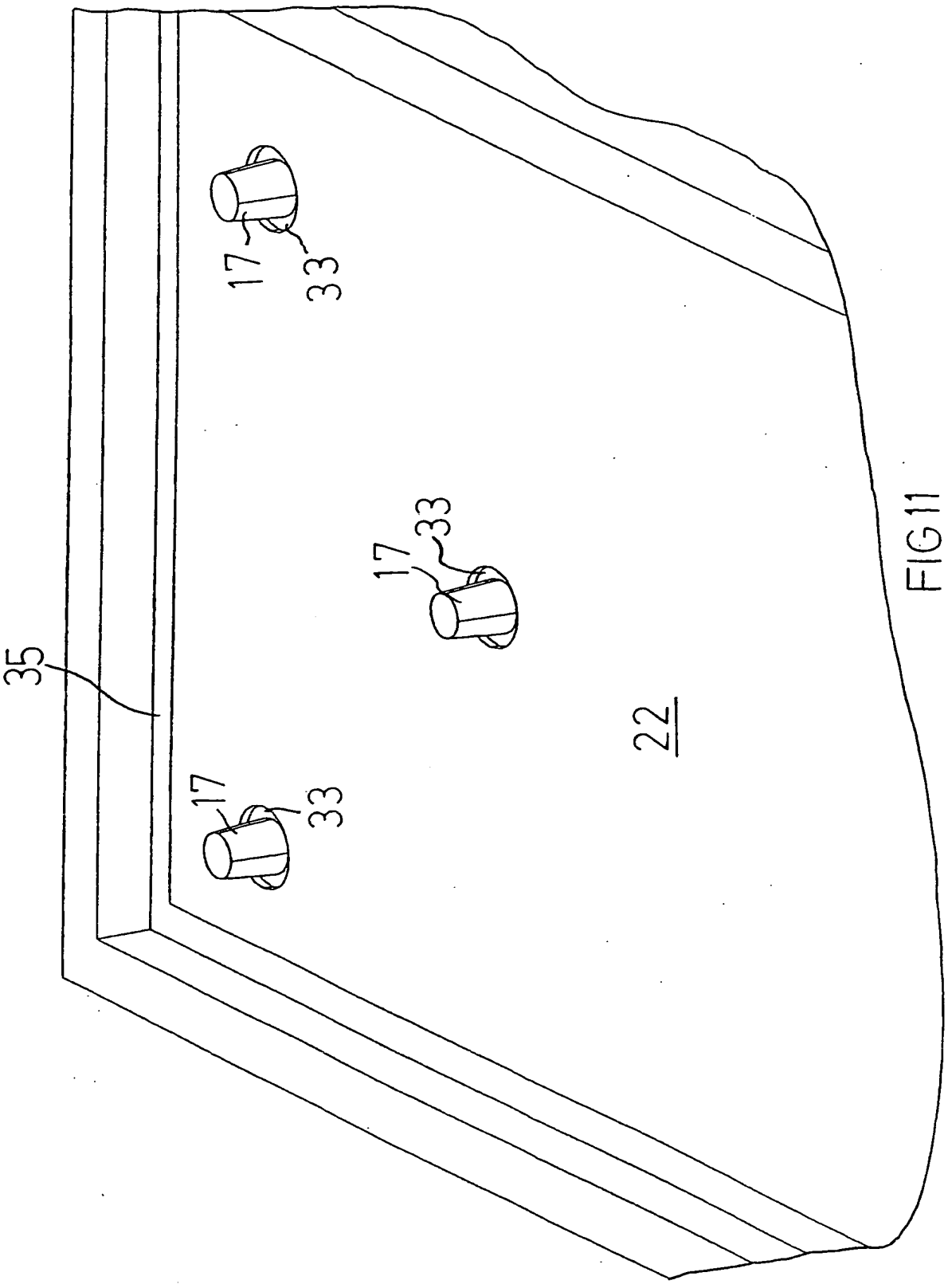


FIG 11

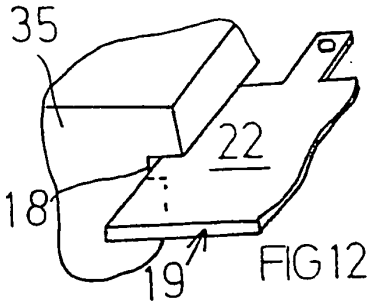


FIG 12 a

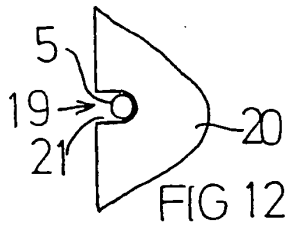


FIG 12 b

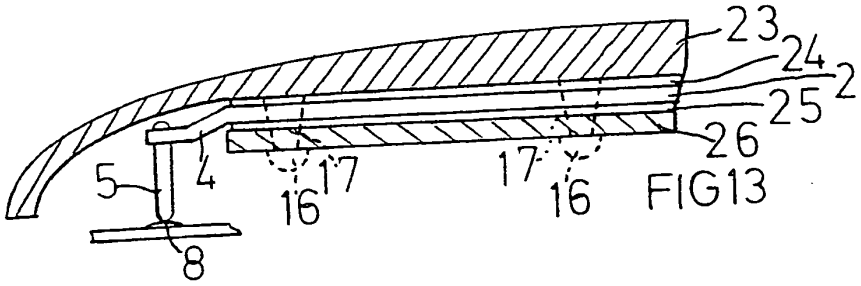


FIG 13

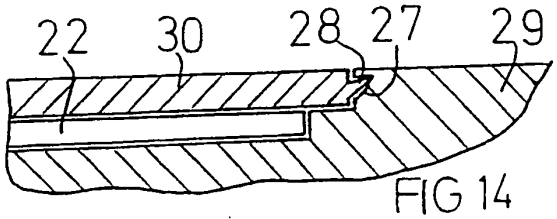


FIG 14

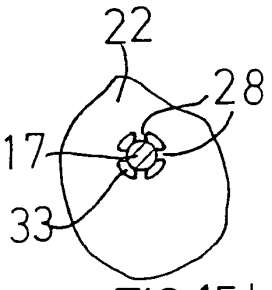


FIG 15 b

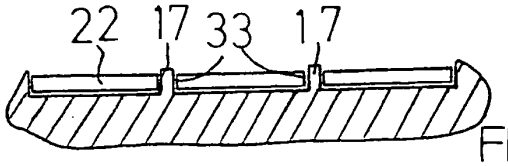


FIG 15 a

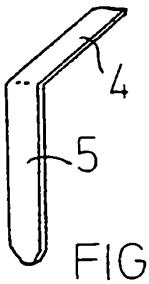


FIG 7

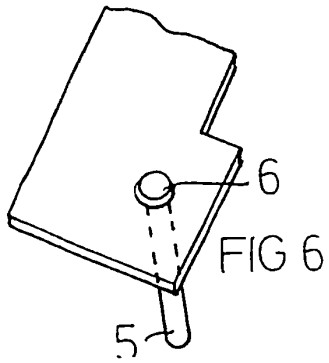


FIG 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 00/01018

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H01Q 1/22, H01Q 1/24
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: H01Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 9809342 A1 (TELEFONAKTIEBOLAGET LM ERICSSON (PUBL)), 5 March 1998 (05.03.98) -- --------	1-28

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" erlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 Sept 2000	18 -09- 2000
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Rune Bengtsson/AE Telephone No. +46 8 782 25 00

210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

28/06/00

International application No.
PCT/SE 00/01018

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9809342 A1	05/03/98	AU 3872597 A	19/03/98
		CN 1228879 A	15/09/99
		GB 2333903 A	04/08/99
		GB 9904563 D	00/00/00
		SE 507244 C	27/04/98
		SE 9603136 A	01/03/98
		US 6016125 A	18/01/00